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Workshop on the Establishment of a Consultative Group on Solar Energy Research and Applications (COSERA)

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by the

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International trends in solar energy research and application

1. In spite of the changing scenarios of prices and availability of alternative fuels, research and development relating to the utilization of solar energy is proceeding and the costs of solar energy components and equipment are declining. Neither of these developments is taking place at a pace which is needed but it is still clear that notwithstanding the present relatively high cost of solar energy, countries have to prepare themselves for large-scale utilization of solar energy though within a somewhat uncertain timeframe. In the meantime solar energy research and application seem to be reaching the cross-roads.

2. In the case of photovoltaics for which more information is available than for other categories of application or research, the actual worldwide shipments, which up to 1984 were increasing, appear now to be stagnant. It has been clear to the industry and to its "watchers" that the earlier projections of the growth of markets for solar photovoltaics have been too optimistic. Long-term forecasts for the year 2000 and beyond, however, continue to be optimistic, particularly because of the rapidly increasing conversion efficiencies (from 1 to 2 per cent in 1976 to 11 to 12 per cent in 1985).1/

3. In regard to solar thermal energy, a 1986 report of the United States Solar Energy Industries Association came to the conclusion that "few in the industry expect the market to develop until energy prices rise or federal subsidies for conventional energy technologies and the major question is whether they will rise soon enough to save the industry from dissolving and the technology base from evaporating".2/

4. The trends at the international level relating to research and expenditure on solar energy are worth noting.3/ In the case of the United States where substantial public spending of solar R&D took place there is now a trend of reduction and setbacks in public sector R & D from 561 million in 1980 to 52 million forecast for 1987. The development of solar technology in the major producing countries has

relied heavily on public sector support at three main levels: support for R&D, provision of markets, and raising public awareness of the technology. The support for R&D has been conducted as national programmes and the expansion of the market has involved international agencies and led to the application of photovoltaic technology in the developing countries. While the R&D programmes set price goals in levels of efficiency to be achieved over specific time scales, the expansion of markets provided finances as well as operating experiences that were subsequently used in R&D. Most of the R&D in the United States, Western Europe and Japan has been done through complex government-industry, industry-university and government-university interlinkages. While the quantum of publicly funded R&D in the United States has been declining, different trends are visible in Europe and Japan. West European countries under the auspices of the European Economic Community launched a major programme in the late 1970s involving state agencies, universities, industry and public enterprises. Photovoltaics R&D accounted for US$15.5 million over the 1975-79 period and was increased by some 190 per cent to reach US$59 million over the 1979-83 period. The work in Europe was subcontracted to universities, research institutes and industry in the various European countries. Like the US, the EEC programme undertook R&D specifically to reduce selling costs by improved processing and alternative materials. The various European countries also support photovoltaic R&D through national programmes. France, for example, has set aside US$154 million for photovoltaic development over the 1982-86 period of which the Government's contribution amounts to US$52 million. The FRG Federal Ministry for Research and Technology spent the following amounts on photovolatics research: In the years 1972-1977 DM10 million (i.e. 4.5 per cent of total appropriations for research on non-nuclear energy); in the years 1978-1982 this was increased to DM 95 million (9 per cent of total); from 1983-1987 research expenditure on pv reached an all-time high of DM300 million (28 per cent of total); and forecasts for the period 1988-1992 expect a decline in non-nuclear research funding from DM1.1 billion in 1988 to DM810 million in 1992, with a corresponding reduction in pv research from DM270 million in 1988 to DM160 million in 1992 (26 per cent and 20 per cent of total, respectively).

5. Photovoltaic R&D in Japan is conducted under the "sunshine project" launched in 1974. The funding for photovoltaics has been increasing rapidly. For example, the funding was raised over 140 per cent during the 1980-82 period alone, bringing the total allocation to US$30 million. By 1984 Japan was spending some US$16 million on photovoltaic R&D, equally shared by industry and the Government.

6. Even with the recent reductions in some national R&D budgets, it has been estimated that some US$100 million per annum is spent worldwide on pv research.

7. Some amount of information is also available about the trends in developing countries. The photovoltaic applications in developing countries have been made primarily through the efforts of some companies and through international agencies. The United Nations Development Programme, for example, has funded a World Bank-executed project on photovoltaics. The finding of workshops organized by UNDP recently have resulted in the conclusion that after numerous demonstration projects during the period 1975-83 photovoltaics has been proven to operate in remote locations and even under harsh conditions.4/ Photovoltaics is an economically competitive source of electric power for many applications and in many locations. Such applications now particularly improved remote power for clinics, schools and other buildings, refrigeration for medicinal vaccines, water pumping for lifestock, irrigation, and clean drinking water, and communications. Financing institutions, such as the World Bank, African Development Bank and Asian Development Bank are prepared to finance economically sound uses of photovoltaics as a component of a rural, agricultural energy development programme or a rural health scheme.

8. In regard to production in the developing countries a start has been made, though there has been no significant commercialization of photovoltaic systems from local R&D. So far their output has only changed from a minuscule 0.2 unit mW in 1983 to 0.70 mW in 1984.5/ The largest growth rate appears to have been recorded in India while the rest of the developing country shipments is accounted for by Brazil and Singapore which have assembly facilities. Saudi Arabia has set up a

single custom module plant aimed at supplying local and regional markets. At the same time the developing countries have remained targets of photovoltaic commercialization despite the disappointing sales in the last five years. The EEC is a major supplier of modules to these countries as part of their aid programmes. Individual countries, such as Italy and France ship over half of their photovoltaic output to developing countries, mainly to Africa.

Trends in solar research and development in developing countries

9. A review of research institutes in developing countries carried out by UNIDO in 1982 and updated in 1985 and 1986 showed that out of 115 institutes included in the most recent review, 6/ 43 were involved with the research of photovoltaics (solar cell technology and systems) and 25 with solar thermal (flat plate and concentrating) collectors; 15 with solar thermal systems and 6 with selective coatings. Main applications were solar drying (47), water heating (33), cooling and refrigeration (24), solar cooker (16) and water pumping (13); 6 were engaged in research in industrial heat process. The expenditure on research and development does not, however, appear to be considerable. An analysis of the research budgets for 1984-85 of institutes listed in the above review, shows that these budgets range from US$10,000 to several million dollars. At the low end of the scale are Iran, Trinidad and Tobago and Cameroon while Singapore and the Kingdom of Saudi Arabia are on top of the list with 12 and 8 million, respectively. The great majority, however, have a rather modest budget of 100,000 to 200,000 with an average professional staff of five.

10. Annex I shows a list of research institutes in developing countries and their areas of research and the co-operation they are currently having with institutions in other countries. The table shows clearly that a certain amount of co-operation already exists in solar energy research. Such co-operation has taken different forms, such as co-operation with aid agencies, non-governmental development-oriented organizations, governments and United Nations organizations. It is interesting to note that several cases of co-operation between developing country institutions themselves also exist.

11. At the same time it is clear that constraints are faced by developing countries in regard to research and more particularly in regard to commercialization, which appears to be a weak link. Even with regard to the manufacturing activities undertaken in developing countries, many of the applications would appear to be based on imported technologies. One recent Swedish study noted that "the lack of contact and co-operation between many scientists in the developing world is a major obstacle to a more rapid introduction of solar systems. Countries such as Egypt and Kenya, both have well-reputed research institutes and local manufacturers, but contacts between these parties are few and occasional".7/ Nevertheless, it is evident that a great deal of interest in further co-operation exists as is seen from Annex II which presents the information collected by UNIDO on the interest evinced by institutions in various countries in co-operating with institutes outside. Interest in co-operative research has been expressed by 14 countries in photovoltaic systems, 11 in solar drying, 10 in solar cells, 9 in water heating and 5 in solar collectors.

Some existing forms of co-operation

12. In regard to international co-operation in general it is useful to take note of some of the existing attempts at co-operation which are, however, primarily at the regional level.

13. The European Network for Solar Energy Co-operation was formally launched in September 1983 at the initiative of UNESCO. UNIDO is also a member of the network. Bulgaria, USSR, Hungary, Rumania, Poland, Yugoslavia, Israel, FRG and France are reported to be in the Network Committee. Working groups have been set up with focal points in different countries in regard to solar water heating, heat storage, solar drying and another working group on photovoltaics and its applications. The types of activities identified relate to the exchange of personnel, working in participants' laboratories and impartial assessment at the highest intellectual level. It has been agreed that the collective knowledge of the European Network would be available for the encouragement of the developing countries and that a wasteful duplication of individual projects could be eliminated by co-operation.

14. In regard to the ESCAP region projects are reported to be implemented at the regional level in research, development and demonstration on solar photovoltaic systems in co-operation with the Government of Japan.

15. Based on the expertise acquired through national and bilateral projects in Indonesia and Pakistan in photovoltaic power generation, assistance is being provided to developing countries in the region and for sharing experience as well as the training of engineers and technicians in the establishment, operation and evaluation of solar photovoltaic systems. The Indonesia-Japan photovoltaic power generation system project is proposed to be used as a regional research, development and demonstration project.

16. A Silicon Technology Development Institute has been established in Pakistan through a project funded by the Government of Pakistan and UNFSSTD and implemented by UNIDO. It provides an excellent nucleus for training, research and pilot production of complete PV arrays, starting from quartz and can be strengthened for co-operation with other developing countries.

17. In the ESCWA region network on new and renewable sources of energy (mainly solar) is being established. A meeting on solar and wind energy will be held in November 1986 in the ESCWA region.

18. In regard to the African region, the Solar Energy Society of Africa was established in November 1983 and its research priorities include solar crop drying, water supply for irrigation, solar maps and airconditioning including passive heating and cooling. The activities envisaged for this society include organization of seminars, exchange of personnel, material and equipment, establishment of links with other proficient organizations, development of co-operative programmes, preparation of directories etc.

19. The International Solar Energy Society, a worldwide non-profit organization founded in 1957 and with members in more than 90 of the world's countries is widely regarded as the premier body of its type

operating in the solar energy field. It has consultative status with the United Nations as a non-governmental organization. The Society has among its members most of the world's leading figures in solar energy research and development.

20. The Society convenes biannual world congresses as a multidisciplinary forum for experts to review and compare notes on latest developments of solar technology and also organizes an international solar equipment exhibition in conjunction with each congress. After Brighton, UK (1981), Perth, Australia (1983) and Montreal, Canada (1985), Hamburg, FRG has been selected for the 1987 congress.

21. The rather brief and limited review of some of the existing efforts of co-operation would show that useful beginnings have been made. However, it is not at all evident that the resources available for solar energy research and application are significantly increased or are being coordinated in a way which is necessary to impart a decisive thrust to this field, which is of particular importance to developing countries and to global energy issues in general.

22. A number of aid agencies have been meeting informally from time to time to discuss their support for research relating to energy in developing countries.8/ The first two of these informal meetings were organized by IDRC in April 1982 and September 1984. A third meeting was held at the GTZ Headquarters in May 1986. It should be noted that these were informal meetings for the energy sector as a whole and no particular focus was put on solar energy. Developing countries do not appear to have been represented at such meetings. It may also be noted that while global networks have been created for biomass (Biomass Users Network) and rural energy (Rural Energy Technology and Innovation Network) no such network exists for solar energy. It is reported that the participants in the informal donors meetings expressed concern that in light of the volatile energy market, developing countries should not be discouraged from taking the necessary energy investment decisions. The participants also decided that donors should increasingly focus their support on research into energy-related development constraints and opportunities. The final results of the IDRC's Energy Research Group were also discussed

and among other things attention was drawn to the following: research must be demand-oriented; user-oriented strategies are needed; energy research priorities must evolve as a result of policy decisions; and research capacities must be built up in developing countries.

Need for a Consultative Group on Solar Energy Research and Applications (COSERA)

23. The foregoing makes it clear that a stage has been reached where a more decisive thrust towards co-operation is needed. Among the factors contributing to this result are the following: the relatively stagnant trends in solar energy equipment production and shipments; the somewhat conflicting trends in regard to the quantum of research funds being channelled into the field of solar energy; the availability of a certain amount of experience in the utilization of solar energy equipment by the developing countries; the existence of a large number of institutions in developing countries doing research in the field of solar energy; and not least the expressed desire for international co-operation. This together with the ongoing, though limited, co-operation at the regional level provide the scope for the establishment of a Consultative Group on Solar Energy Research and Applications (COSERA) at the international level with the aim of promoting a critical mass of international effort related to solar energy research and application, in particular for the benefit of the developing countries.

24. The context of UNIDO's involvement in promoting the Group may be set out at this stage. UNIDO has been working in the field of solar energy by way of information collection and dissemination, preparation of studies and directories and specific technical assistance projects (for example in Afghanistan, Comoro Islands, Cuba, Ethiopia, Jordan, Mali, Niger and the Sudan). As part of its programme for strengthening the technological capabilities of developing countries in the fields of new and emerging technologies the UNIDO Secretariat brought up the subject of solar energy at the International Forum on Technological Advances and Development, held in Tbilisi, USSR, in April 1983. The Forum recommended in its report[9/] the establishment of a Consultative Group on Solar Energy

Research and Applications (COSERA). The particular interest of UNIDO is that solar energy research must not only be accelerated as a longterm energy imperative but the beginnings of a solar energy industry have to be nurtured in many developing countries matched by the strengthening of the relevant scientific and technological capabilities. The growth of such an industry is likely to be substantially hampered if the developing countries do not have a measure of research and application capacity. The building of systems for local use requires essentially local knowledge and local research capabilities which will then have to be related to the local manufacturing capabilities. This is not to argue that the work in developing countries should be confined to applications or that they should not go into the field of research in fundamental areas. The creation of an international group will actually open up the possibilities of co-operation and avoidance of duplication and of accelerating results where a certain measure of excellence has already been achieved.

25. In the activities of such a group at the international level it should, however, be borne in mind that existing regional networks must be utilized; national capacities should be fostered and activities at the international level should not be at the expense of those at the national level; there should be no attempt to "reinvent the wheel" and on the other hand, stress should be put on avoidance of duplication consistent with the growth of national capacities in the manner desired by individual countries and translating the research into actual application and production. A consultative group, however, can function effectively only if sufficient funds are available and has as its members key actors in this area including donor agencies and several "centres of excellence" or high-level institutions in developing countries. It is in this context that attention has to be given to the experience of the Consultative Group on International Agricultural Research (CGIAR), the set-up of which is explained later in this paper. The UNIDO Secretariat believes that next to agriculture, solar energy is an area deserving attention considering its renewable nature and its importance to all countries and in particular developing countries. Hence a group modelled on the CGIAR but not necessarily to be on all fours with that body would be useful.

26. A Consultative Group on International Solar Energy Research and Applications could take various forms. Typically several activities could be envisaged, such as information exchange, training, joint research and development, periodical review of the state of the art, measures to promote the commercialization of the technologies developed, etc. A consultative group of this type could also promote specialized "centres of excellence" with regional or international scope in specific subject areas. In addition, it could be directly linked with funding for research, following the pattern of the Consultative Group on International Agricultural Research (CGIAR). The last element is critical, if the group is to achieve the desired results.

Experience with the Consultative Group on International Agricultural Research (CGIAR)

27. The CGIAR established in 1971 under the joint sponsorship of the World Bank, UNDP and FAO is an informal association of governments, international and regional organizations and private foundations dedicated to supporting a system of agricultural research centres and programmes around the world. CGIAR operates without any legal charter, written rules, protocols or by-laws, inter-alia, by the common consent, shared interest and good will of its members. Members of the CGIAR meet annually to consider programme and budget proposals, policy issues and other matters from the centres. The initiative was taken on the belief that long-term support for an expanded international agricultural research system should be provided. It is widely recognized that this experiment has been highly successful. Annex III shows, for example, that the contributions to CGIAR for the first ten years of its operation increased more than fivefold from US$20 million in 1972 to US$119 million in 1980. Annex IV gives additional information covering the period up to 1985.

Proposal for a Consultative Group on Solar Energy Research and Applications (COSERA)

28. Based on the foregoing it is suggested that careful consideration be given to the establishment of a Consultative Group on Solar Energy Reserach and Applications composed of R&D institutions, particularly from

developing countries, and donor agencies with the aim of imparting direction and cohesion to and increasing the size and accelerating the speed of international research effort in the field of solar energy, particularly for applications in developing countries. It will draw upon the experience of CGIAR but need not necessarily be identical in organization. The COSERA could also have a certain amount of emphasis on industrial production and application. It should, however, be remembered that such a group need not be an intergovernmental group but could be organized as an informal group of those donors and research institutions willing to participate. The Group will not "dictate" what needs to be done in individual countries but rather try to harmonize to the extent possible individual national efforts with international research concerns and the approach of donor countries. It will have to function with a minimum of legal or bureaucratic constraints. However certain "rules of the game" will have to be observed and there will be a minimum level of obligation on the part of the donors as well as on the part of the participating research institutions, particularly in regard to provision of information and willingness to discuss the results of their various efforts and experience, particularly relating to developing countries. COSERA will not preclude any bilateral co-operation now or in the future, nor will it substitute the individual efforts of countries or hinder or replace existing commercial flows. On the other hand, it is believed, that this group could contribute both to the creation of a solar energy industry in developing countries by promoting more concentrated research and linking it to industrial application and also to the opening up of potential markets for international commerce. The group will also establish links with the efforts of agencies in the United Nations system.

29. It would appear that considering the present stage of solar energy research and application and the need for a more concerted effort as well as for a long-term support of a critical mass, the creation of a Consultative Group on Solar Energy Research and Applications (COSERA) drawing, among others, on the experience of the CGIAR, is both timely and essential. Based on the inputs provided by various participants in the workshop, it should be possible to establish the COSERA after appropriate consultations with all interested donor agencies and as many developing country institutions as possible and after elaboration of its proposed

institutional framework. The present workshop has necessarily to be limited to a few expert participants and observers, the intention being to concretize the thoughts in this respect a little more before reaching out to a wider level of participation.

30. The workshop may like to discuss the foregoing and arrive at proposals for concrete further action in this matter, and in particular for UNIDO to:

(a) prepare for and convene a meeting of all interested institutions to establish the COSERA; this would include the surveying and identification of interested R&D institutions, detailed consultation with donor agencies, and elaboration of the framework of the group.

(b) identify subject areas of research and application where efforts at international co-operation may be primarily directed; and

(c) concurrently build up a portfolio of R&D projects in developing countries to be promoted and assisted by international co-operation. (It is requested that participants bring for this workshop concrete proposals for co-operation in research and application.)

Footnotes

1/ Figures quoted in this paragraph are taken from different issues of Solar Energy Intelligence Report

2/ Solar Energy Intelligence Report, 25 February 1986.

3/ Figures in the rest of the paragraph are taken from draft report for UNIDO by K. Hoffman "Technological and Commercial Trends in Photovoltaics".

4/ See report of UNDP Renewable Energy Information Programme--Photovoltaic Symposia and Information Workshops, Nairobi, Kenya, 13-18 April 1986 and Chiang Mai, Thailand, 20-25 April 1986.

5/ Draft report by K. Hoffman, op. cit.

6/ UNIDO/IS.341/Rev.2 "Directory of Solar Research Institutes in Developing Countries".

7/ "Solar Water Heating in Developing Countries", Swedish International Development Agency (SIDA), March 1984, quoted on page 36, "Building the renewable energy market in developing countries", Commission of the European Communities.

8/ GATE, questions, answers, information, September 1986, No.3/86.

9/ Report of the International Forum on Technological Advances and Development, ID/WG.389/6, para.71.

ANNEX I

Indicative list of research in developing countries

COUNTRY	Suggested areas of cooperation	Joint research with
Algeria	solar cells (incld.a-Si)	
Argentina	solar cells (+ a-Si) pv systems collectors solar drying energy conservation	Brazil (R+D)
CARIBBEAN	exchange of information	GATE VITA
Brazil	solar cells (MIS+SIS technology) (a-Si)	
Burundi	solar drying	USAID EEC FRG UNESCO-ANSTI Belgium (R+D, Gov.)
Cameroon	solar drying refrigeration	France (R+D)
Egypt	desert development	USAID UK USA (R+D)
Ethiopia	solar drying	ARCT
Fiji	pv solar radiation measurement refrigeration	UN Pacific Energy Programme
Ghana	solar pumping(pv) solar drying solar cookers	GTZ Togo Benin (R+D)
India	solar distillation solar drying solar cells solar cooker solar pumping , solar water heating ind. process heat desalination refrigeration flat plat collectors selective coatings sterling engine	ITDG FRG (gov) UK (R+D) IRRI (Phil) Swiss Dev.Corp. France (gov) Peru (R+D) UNU UNESCO UNFSSTD

Iran	**desalination**	
Iraq	**desalination** **water pumping (pv)** **solar cells** **refrigeration**	**Jordan (R+D)**
Indonesia	solar cells water pumping (thermal) pv systems solar drying solar water heater	FRG (R+D) UNFSSTD
Jordan	solar water heating flat plate collectors desalination	GTZ KISR
Kenya	solar drying	CSC (Africa Energy Programme)
Madagascar	solar cells solar thermal	France (R+D) planned: Indian Ocean countries
Malawi	solar drying solar still	
Malaysia	solar thermal solar dryers solar radiation pv solar cooling	New Energy Development Organization, Japan JILA, Japan KAIST . Korea France (gov) France (R+D) USA (commercial)
Mali		France (R+D) USA (commercial)
Mexico	water pumping (thermal + pv) concentrating collectors cooling	France (gov)
Morocco		France (R+D)
Nepal	solar water heating space heating	
Nigeria	exchange of information/visits energy conservation passive solar	

Pakistan	pv solar cell materials passive solar rural energy	USA (R+D) Turkey (R+D) ATDO
Papua New Guinea	solar drying	
China	pv solar cell design (a-Si and polycristal) collectors solar drying solar thermal space heating water heating energy conservation desalination	
Philippines	solar grade silicon from rice husks	USAID UNDP UNESCO FRG (gov) AGSAT
Korea	pv passive solar active solar	France (commercial)
Saudi Arabia		USA (R+D) KISR
Senegal	rural energy water pumping (pv) desalination	Mali France (commercial)
Seychelles		Reunion (R+D)
Singapore	energy conservation (computer simulation) air conditioning passive solar water pumping (pv) solar ponds	GTZ USA (gov)
Sri Lanka	water heaters	

Syria	**air conditioning** **water heating** **solar cells (encapsulation)** **pv systems** **selective coatings**	**Algeria**
Tanzania	rural energy refrigeration water pumping solar cooker solar drying pv	CSC Canada (R+D) Uganda (R+D) Kenya (R+D)
Thailand	solar pond collectors (water heating) solar still rural electrification solar drying distillation	Japan (R+D)
Trinidad and Tobago		Canada (R+D) CARDI Grenada
Turkey		
Uganda		CSC: Kenya Tanzania Zambia, Malawi Zimbabwe, Mauritius Seychelles, Cyprus
Venezuela	energy conservation passive cooling simulation of thermal processes	Mexico (R+D) France (gov)
Yugoslavia	solar cells	
Zambia	solar radiation	
Zimbabwe	solar drying water heating water pumping (thermal)	

Source: **Analysis of document UNIDO/IS.341/Rev.2**

ANNEX II

Co-operative research suggested in:

SOLAR CELLS

Algeria
Argentina
Brazil
India
Indonesia
Madagascar
Pakistan
China
Syria
Yugoslavia

SOLAR DRYING

Argentina
Burundi
Cameroon
Ethiopia
Ghana
India
Indonesia
Kenya
Malaysia
Tanzania
Zimbabwe

PV SYSTEMS

Argentina
Fiji
Ghana (pumping)
Iraq (pumping)
Indonesia
Mexico (pumping)
Malaysia
Pakistan
China
Senegal (pumping)
Singapore
Syria
Tanzania
India (pumping)

WATER HEATING

India
Indonesia
Jordan
Nepal
China
Sri Lanka
Syria
Zimbabwe
Thailand

COLLECTORS

Argentina
India
Jordan
Mexico
China

Source: document UNIDO/IS.341/Rev.2

ANNEX III

CGIAR
DONOR CONTRIBUTIONS 1972-1981
($ millions)

	Actual									Estimated
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981 1/
African Dev. Bank							.025	.030	.040	.050
Arab Fund						.310	.310		.255	.255
Asian Dev. Bank				.300		.500	-	.700	-	-
Australia		.005	1.015	1.215	1.745	1.790	2.580	2.650	2.955	3.315
Belgium	.140	.600	.380	.620	1.740	2.250	2.720	3.085	3.265	3.530
Canada	1.160	1.780	4.675	4.340	5.390	6.800	7.370	7.544	6.875	7.620
Denmark	.250	.225	.370	.400	.455	.615	.760	1.045	1.210	1.170
EEC						2.500	2.240	3.790	4.545	5.460
Ford Foundation	5.315	3.675	3.000	2.800	2.000	1.590	1.000	1.000	1.300	1.300
France			.130	.410	.510	.415	.340	.675	.855	1.095
Germany		1.805	3.040	3.935	4.475	5.350	6.760	8.475	10.100	10.000
IDB			2.030	4.120	5.000	5.700	6.185	6.200	6.700	7.400
IDRC	.175	.345	.645	.990	1.780	1.305	1.045	1.818	1.530	1.075
IFAD							-	1.550	3.570	6.570
India										.500
Iran					1.975	2.000	1.000	-	-	-
Ireland							-	-	.200	.200
Italy					.100	.030	.100	.100	.700	1.250
Japan	.105	.230	.265	.675	1.200	2.500	3.500	4.845	7.000	8.400
Kellogg Foundation	.155	.290	.280	.290	.300	.310	.320	-	-	-
Leverhulme							-	-	.490	.585
Mexico							-	-	.495	1.000
Netherlands	.375	.430	.555	1.235	1.500	1.720	1.785	2.430	2.600	3.070
New Zealand					.105	.025	.025	.025	.025	-
Nigeria				.645	.645	.620	.790	.825	1.976	1.720
Norway	.075	.185	.445	.810	1.120	1.510	1.880	1.975	1.995	2.000
OPEC Fund							-	-	.900	1.000
Philippines							-	-	.150	.500
Rockefeller Foundation	3.990	4.545	3.500	2.885	2.165	1.595	1.250	1.220	1.600	1.000
Saudi Arabia					1.000	1.000	-	-	-	-
Spain										.500
Sweden	1.000	.150	1.490	2.290	2.255	2.240	2.725	3.115	3.390	3.525
Switzerland		.410	.140	.460	.855	1.205	1.350	1.850	2.450	2.580
United Kingdom	.690	1.110	1.920	2.410	2.890	3.515	4.765	6.395	6.790	7.140
UNDP	.850	1.000	1.465	2.165	1.930	3.500	4.400	3.995	4.615	4.981
UNEP				.600	.340	.340	-	.150	-	-
United States	3.770	5.390	6.805	10.755	14.870	18.140	21.145	24.800	29.000	35.000
World Bank	1.260	2.780	2.375	3.195	6.525	7.850	8.675	10.200	12.000	14.600
Others										
Kresge	.750									
TOTAL	20.060	24.955	34.525	47.545	62.870	77.225	85.045	99.487	119.576	138.391

Source: Centers' Program and Budget Papers and accounts, 1974-1981.

1/ Contributions as pledged November 1980. Values will vary depending on date of disbursement.

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ANNEX IV

CGIAR: **Donor contributions to center programs, 1972-85 (in US$ million).**

Donor	Core Programs						Total (Core + Non-core)		
	1972-76	1977-81	1982	1983	1984	1985	1983	1984	1985
Australia	4.00	13.28	3.77	4.06	4.00	4.18	4.11	4.03	4.27
Belgium	3.48	13.70	1.85	1.88	1.71	2.01	2.46	2.31	2.66
Brazil	—	—	—	—	1.00	—	—	1.00	—
Canada	17.37	36.14	8.29	9.94	10.03	9.70	10.74	11.58	12.74
China	—	—	—	—	0.50	0.50	—	0.50	0.50
Denmark	1.71	4.69	0.96	0.95	1.24	1.12	0.95	1.24	1.26
Finland	—	—	—	—	0.50	0.60	—	0.50	0.60
France	1.05	3.14	0.90	1.01	0.88	1.23	1.10	0.94	1.39
Germany, Fed. Rep.	13.27	39.06	7.84	7.89	6.67	6.15	8.68	7.39	8.14
India	—	0.50	0.50	0.50	0.50	0.49	0.50	0.50	0.49
Iran	1.98	3.00	—	—	—	—	—	—	—
Ireland	—	0.38	0.21	0.34	0.41	0.40	0.34	0.41	0.40
Italy	0.10	1.90	1.59	6.10	6.62	6.49	6.10	6.62	6.78
Japan	2.49	26.25	8.85	9.13	9.72	11.09	9.48	10.46	12.05
Mexico	—	1.45	0.10	0.15	1.22	0.37	0.15	1.44	0.47
Netherlands	4.11	11.54	3.24	3.58	3.28	3.89	4.12	3.79	4.53
New Zealand	0.11	0.14	0.02	0.02	0.02	0.01	0.02	0.02	0.01
Nigeria	1.30	5.36	1.13	1.00	1.00	0.85	1.40	1.60	1.29
Norway	3.33	9.27	1.87	2.19	1.92	2.27	2.19	1.92	2.27
Philippines	—	0.65	0.45	0.35	0.32	0.23	0.35	0.32	0.23
Saudi Arabia	1.00	1.00	—	1.50	1.50	—	1.50	1.50	—
Spain	—	0.50	0.46	0.52	0.52	0.50	0.52	0.52	0.50
Sweden	7.19	14.80	3.18	3.05	3.07	3.02	3.05	3.07	3.02
Switzerland	1.87	9.47	2.76	4.89	6.70	5.17	5.91	8.21	7.80
United Kingdom	9.02	27.51	6.34	5.92	5.66	6.32	5.98	5.74	6.33
United States	41.60	128.09	40.79	44.55	45.25	45.16	55.02	56.85	60.19
Country Subtotal	114.98	351.82	95.11	109.52	114.23	111.74	124.67	132.46	137.90
Ford	16.79	6.20	0.81	1.31	0.99	0.90	1.75	1.37	1.68
Kellogg	1.32	0.63	—	0.63	0.34	—	0.69	0.41	—
Kresge	0.75	—	—	—	—	—	—	—	—
Leverhulme	—	1.08	0.65	0.75	0.81	0.60	0.75	0.81	0.60
Rockefeller	17.10	6.67	0.80	0.50	0.50	0.80	0.54	0.55	0.99
Foundation Subtotal	35.96	14.58	2.26	3.19	2.64	2.30	3.72	3.14	3.27
ADB	0.30	1.20	—	—	—	—	0.17	0.45	0.64
AFDB	—	0.15	0.02	—	—	—	—	—	—
AFESD	—	1.12	0.24	0.23	0.23	0.34	0.23	0.23	0.34
EC	—	17.38	4.72	5.16	4.72	6.58	6.25	6.01	7.95
IDB	11.15	32.19	8.10	8.16	8.73	8.17	8.16	8.73	8.17
IDRC	3.95	5.68	1.20	1.80	1.01	1.30	2.45	2.78	3.12
IFAD	—	11.05	5.94	8.37	7.02	3.15	10.31	8.67	5.26
OPEC	—	1.90	3.58	2.25	2.19	1.00	2.25	2.19	1.05
UNDP	7.42	21.59	6.19	6.86	8.06	7.49	7.16	9.12	8.85
UNEP	0.94	0.49	0.18	0.13	0.03	—	0.17	0.03	0.02
WORLD BANK (IBRD)	16.15	53.33	16.30	19.00	24.30	28.10	19.50	24.68	28.87
International Donor Subtotal	39.91	146.08	46.47	51.96	56.29	56.13	56.65	62.88	64.27
Other Donors	—	—	—	—	—	—	3.29	4.60	4.37
TOTAL	190.85	512.48	143.84	164.67	173.16	170.17	188.33	203.08	209.81

Source: CGIAR 1985 Annual Report